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ABSTRACT

The purpose of this unit is to develop basic concepts of measurement. The children will have a variety of experiences which make measurement concepts meaningful to them. This unit will provide some review of counting skills and simple addition and subtraction skills. The primary focus, however, is to build concepts of measurement in length, weight or mass, volume or capacity, and area; and extend them into a simple introduction to the metric system. Activities in each subtopic of this unit suggest ways to accomplish that. The subtopics are: comparisons, ordering, conservation, arbitrary units of measuring, and standard units of measuring. (Author/MP)

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SE 024 893

Introduction to the Unit

This Experimental Teaching Unit is intended to give students some practice in important mathematics skills. There are five sections to the unit, each of which deals with slightly different skills.

For each section the following things are included in this packet:

1. a brief overview of the skill area
2. a list of performance objectives for the students
3. a set of sample instructional materials (you may use those included, select some from another source, or create your own)
4. some suggestions on ways to use the materials and/or other related materials.

Your students will be both pre- and posttested on many of the objectives listed in this unit. To keep the testing to a minimum not all of the objectives are tested directly. Individual scores on the pretest will be provided for you.

Please spend about 25 minutes each day on work related to these objectives. This means that a student working on unit activities should spend no more than about 25 minutes total during the day.

There are many different ways of organizing the materials and of relating one objective to another. Many exercises can be planned to cover more than one objective. If you wish, objectives from different areas can be included in the same lesson. We are interested in the variety of ways to teach these mathematics skills. You may teach as much of the unit to as many of your students as you wish, and in any manner you choose.

As much as possible, please keep track of what materials and activities you use to teach the unit. To help you do this, please follow these procedures:

1. Each of the five sections in the ETU is composed of a set of instructional objectives.
   (a) For each section, select the objectives you plan to use.
   (b) Arrange the objectives in the order in which you paln to use them and place the appropriate number in the space provided. (You will use this number to identify each objective on your teaching record, so do this before you begin the unit.
2. Use the Daily Teaching Record, to keep track of the instructional objectives and the materials or activities you focus on each day.

At the end of the unit we would like to get information from you on questions like:

1. What materials did you use (either from the packet or of your own devising)?
2. In what order were objectives and materials used?
3. Which materials/activities worked well and which less well?
4. What was the reaction of the children to the unit?
5. What procedures did you use for teaching different objectives?

We hope you, as teachers, will feel free to try out different approaches to teaching this unit.

Overview of the Unit

The purpose of this unit is to develop basic concepts of measurement. The child will have a variety of experiences which make measurement concepts meaningful to him. This unit will prcvide some review of counting skills and simple addition and subtraction skills. The primary focus, however, is to build concepts of measurement in length, weight or mass, volume or capacity, and area and extend them into a simple introduction to the metric system. Activities in each subtopic of this Experimental Teaching Unit suggest ways to accomplish that. The subtopics are: comparisons, ordering, conservation, arbitrary units of measuring, and standard units of measuring.

The introduction of the metric system can help develop a stronger feeling for measurement because of the way metrics tie directly into our decimal system of numeration. Pupils can be given extensive opportunities to use measurement tools and acquire skills useful in adult life. This unit should provide a firm foundation for introducing and building the concepts of measurement.

COMPARISONS

Measurement is the process of associating some physical attribute to objects being compared. A child must make many comparisons between objects, using an attribute that is common to all of them, so that measurement activities make sense to him.

Comparisons, in this unit, can be made directly, which means physically moving two or more objects together for comparison; and indirectly, which means using an instrument to compare two or more immovable objects. Comparisons can be made in such a way as to develop a sense of relationships and to develop a notion of length, area, weight or mass, and volume or capacity. Comparisons can also aid the child in becoming more aware of the physical properties of the objects and shapes he handles. "Big" and "small" become better defined and measurable in many ways. Some notions of the number of one attribute compared to the same attribute of another object can be developed. This involves repeated units or a set compared to an object.

OBJECTIVES

The child should be able to:

_____ Compare two or more objects either movable or immovable according to one property and describe them using one of the following terms:

bigger than - or taller, larger, heavier, wider, thicker, longer, etc.
smaller than - or shorter, lighter, narrower, thinner, etc.
the same as - or as tall as, as large as, as thin as, etc.

_____ Compare two or more objects either movable or immovable according to several properties and describe them using one of the following terms:

bigger than - or taller, larger, heavier, wider, thicker, longer, etc.
smaller than - or shorter, lighter, narrower, thinner, etc.
the same as - or as tall as, as large as, as thin as, etc.

CONSERVATION

Conservation refers to the fact that certain properties of objects do not change when you change the position or arrangement of the objects. A child who is able to recognize that a particular "measurement" of an object such as its length, weight (mass), area, or capacity (volume) remains unchanged inspite of any irrelevant transformation made to it, is said to have the ability to conserve the "measurement" involved. For example: if a clay ball is smashed into a pancake shape, the child would recognize that it still has the same weight or mass.

OBJECTIVES

The child should be able to:

_____ Recognize that an object weighs the same despite any change in shape or position.

_____ Recognize that an object is the same length despite any change in shape or position.

_____ Recognize that an object contains the same amount despite any change in shape or position.

_____ Recognize that an object has the same area despite any change in shape or position.

ORDERING

The process of comparing can be extended to include the same attribute of any other objects between the "biggest" (tallest, widest, heaviest, etc.) and the "smallest" (shortest, narrowest, lightest, etc.). Ordering can be made through simple comparisons in which the child makes a step arrangement using the method of finding which is next to the "biggest", etc. Or ordering arrangements can be made by using a third object, such as a cup, a metal washer, a strip of paper, and finding out how many cups, metal washers, or strips of paper equal each, and then ordering the objects according to how many was equal to each object.

OBJECTIVES

The child should be able to:

_____ Arrange several objects in order according to one property. (numbers involved)

_____ Arrange several objects in order according to any one property. (numbers not involved)

ARBITRARY UNITS OF MEASURE

Arbitrary units of measure are natural for children to use in their introductory work in measurement. The instruments can be larger (longer) than the object being measured or they can be smaller (shorter), requiring more than one of them to measure the object. Some decision has to be made as to which to use. At this stage there can be a need for counting and noticing that measurement should be as accurate as possible. An object can be measured with respect to more than one dimension.

OBJECTIVES

The child should be able to:

_____ Recognize the various measures of an object.

_____ Use arbitrary units to describe "how much more" (or how much less) one object is than another.

_____ Recognize a unit of measure is arbitrary by using more than one unit or measuring instrument to measure the given property of an object.

_____ Use an appropriate measuring instrument.*

_____ Estimate the measure of an object.*

_____ Measure an object with accuracy to the nearest arbitrary unit.

*These are important objectives but are not directly tested.

STANDARD UNITS OF MEASURE

The metric system is a more logical system than the English system and it is much easier to learn and use because it is a decimal system. Our money system (dollars and cents) is a decimal system. This means that the units of measure that it uses are based on powers of ten. For example, the metre, the basic unit of length is equal to 10 decimetres, or 100 centimetres.

The whole system is built up by multiplying or dividing by 10, 100, or 1000. Greek prefixes refer to the multiples and Lating to the sub-multiples.

Metric Prefixes	
milli	1/1000
centi	1/100
deci	1/10
deka	10
hecto	100
kilo	1000

There are only three (3) basic units of measure in the metric system to which these prefixes are applied:

Metre - to measure length

Litre - to measure volume or capacity

Gram - to measure weight or mass

OBJECTIVES

The child should be able to:

_____ Name the three basic metric units of measure for length, volume or capacity, and mass or weight.

_____ Choose the appropriate metric unit of measure for a stated common object.

_____ Measure a given length (less than 20 centimetres) to the nearest centimetre.

_____ Weigh a given object (less than 10 grams) to the nearest gram.

_____ Find the liquid measure (less than 2 litres) of a given container to the nearest decilitre.

Suggested Activities - CONSERVATION

C01. Make two clay balls that have the same weight. Use a balance scale to make sure they are the same weight.

a) Take one clay ball and make it into a pancake. Will the pancake have the same weight as the ball?

b) Take one clay ball and break it into pieces; make each piece into a small ball. Will the small balls have the same weight as the big ball?

C02. Provide a number of boxes of different shapes, but which all hold the same amount (cubes or scoopfuls). These boxes may have to be made, or cut from other boxes. Allow children to discover they all hold the same amount, regardless of looks. If they all hold the same amount, is the amount of space inside them about the same?

C03. Use two sticks of the same length. Do simple exercises such as these:

A.

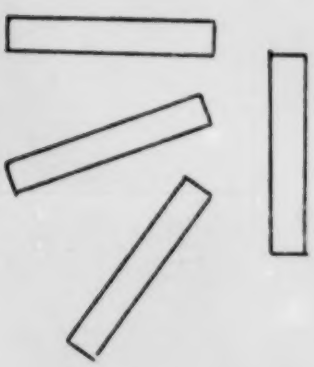
Children should agree two sticks held like this are the same length.

Move one upwards. Children should still see they are both the same length.

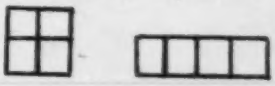
B.

Start again with two sticks.

This time separate them in different directions, each time asking children if they are the same length.



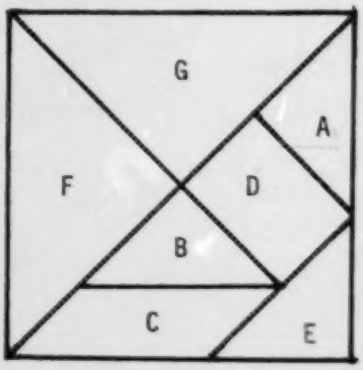
C04. Activity C03 can be used to work with the conservation of area. Take an 8cm square and divide it into 4 equal smaller squares (2cm squares).

Put the four 2cm square units in a line. 

Ask children for opinions as to the amount of area covered.

C05. Use a see-saw, try to find two children in the class that are the same weight, regardless of apparent physical differences. (A tall thin child may be as heavy as a short "chubby" child.) If no see-saw is available, use a plank and a brick to make a see-saw.

C06. Tangram pieces can be used. If none are available, you can make them using stiff paper 8" x 8". Use worksheet 110.



Many areas are equivalent. Children can cover various areas to find these relationships. Some are listed below but they are not sequential.

1. F = G
2. A+B = E
3. A+B = D
4. A+B = C
5. E = C = D
6. A+B+C+D+E = F+G

C07. Use a stick or a strip of paper and a string all the same length. "Measure" equal lengths and have children find them all to be the same.

Example:

piece of paper = 10cm

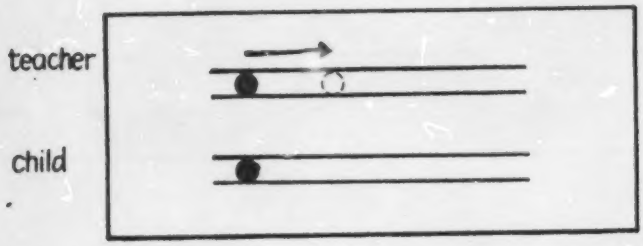
(but not marked)

coiled string equals 10cm (but not marked)

C08. Use worksheet 109 as group activity with sticks or strips of paper about 5cm long.

C09. The teacher should have five sheets of cardboard with parts drawn as illustrated in the diagrams below, and two small counters, which move along them, a green one for the top track and a red one for the lower track.

1



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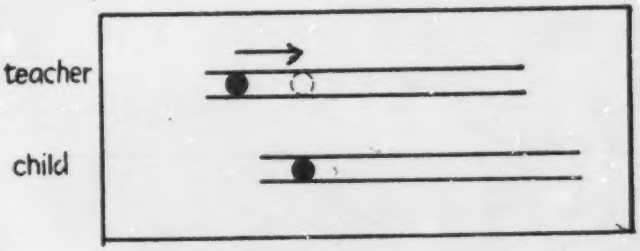

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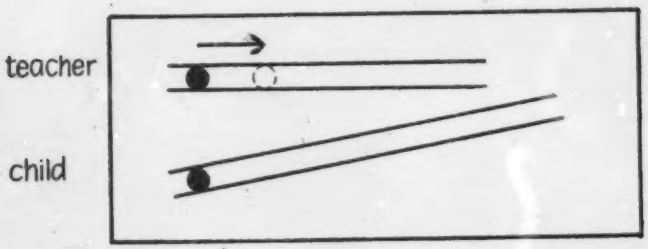

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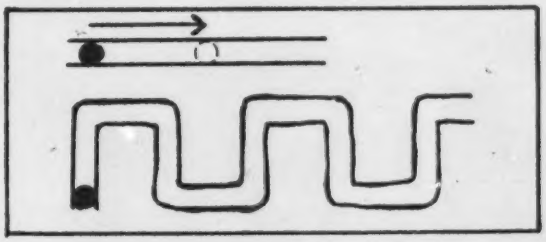

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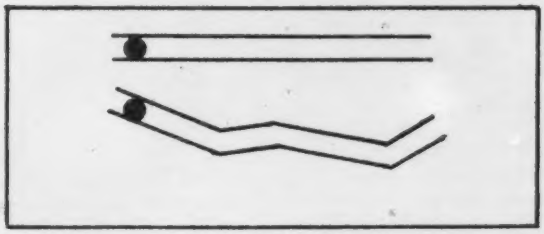


C09. (continued)

There should be on the table a number of measuring instruments, e.g. string, thread, pieces of paper, wooden sticks. There should also be some pieces of paper or sticks that are half the size of one of the segments of the bottom track in situation 4 and some that are the same lengths as the segments of the bottom track in situation 5.

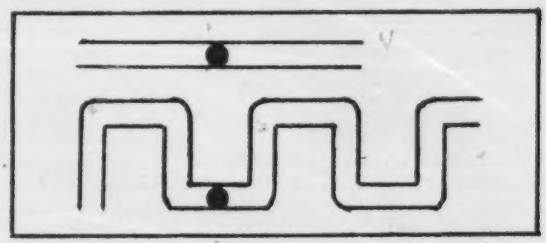
In the first three situations the procedure is identical. The teacher can explain to the child that the counters represent trains travelling along their tracks. "Each time my train is going to travel a certain journey" (the teacher's is always the one on the straight line) "and I'd like you to move yours so that it travels in the same distance as mine"; or, "I'd like your train to travel a journey as long as mine."

At the beginning of the check-up, before anything is explained to the child, the teacher can point to the various pieces of string and paper, sticks, etc., and tell the child that he can use these or anything else on the table to help him. These instructions are not repeated during the activity unless so indicated.

When the child has moved his train the teacher should ask him if there is any way he can be sure that it has travelled the same distance as the green one.

Should the teacher only be using the first three situations, and if the child has not made an attempt to measure, the teacher can then refer to the various pieces of string, sticks, etc. on the table and ask if these might be of help.

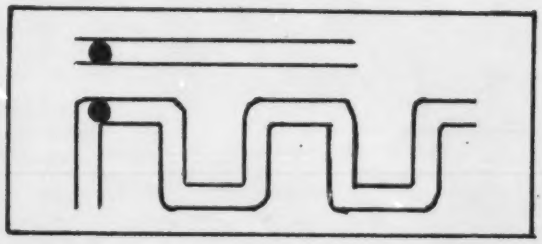
In the fourth situation, should the child place his train opposite the teacher's e.g.,



the teacher and the child should swap trains and return them both to their starting points. This time the teacher moves the red train to about the middle of the fourth segment and asks the child to move his train so that it travels the same distance. If the child still places his train opposite, both trains can be taken back to the shed. The teacher can then move the red one to the end of the first segment, and although it will have travelled a certain distance

C09. (continued)

it will still be opposite the green train, as this segment runs at right angles to the top track.



The child is then asked to move his train the same distance.

Another way of proceeding that may help the child is to suggest (when the teacher's train is at about the middle of the fourth segment) that the trains are going back to the shed. However, the teacher moves her train only one segment at a time and asks the child at each pause to move his train back an equal amount.

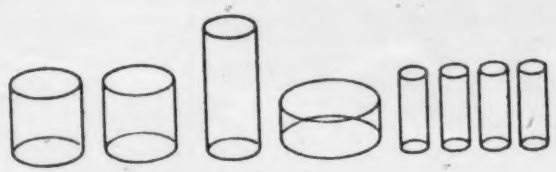
For the children who have been only visually estimating the distance moved by the two trains, the teacher can suggest that perhaps the string, thread or sticks might be of use.

C010. Use a jug of colored liquid, two glass beakers the same size and shape, one jar taller and narrower than the beakers and another shorter and wider, and a set of four glasses as nearly identical as possible, and much narrower than the beakers.

Pour some colored liquid into one of the glass beakers until it is about half full and ask the child to pour about the same amount into the other beaker. The child must agree that there is the same amount to drink in both glasses, before continuing.

There are three parts to this activity and the questions are the same in each. The water is poured from one of the beakers into the tall, thin jar and the child is asked: "Is there the same amount to drink in this glass as there is in the other beaker, or is there more in one?" He is also asked to explain his reply. Before pouring the water from the tall, thin jar back into the beaker the teacher asks the child to anticipate whether or not the two beakers will then have the same amount of water in them.

This procedure is repeated for the shorter but wider jar, and then by distributing the water between the set of four glasses, and each time the teacher should ask the same questions.



C011. The teacher should have two identical green sheets of paper or, preferably, cardboard and a number of cubes of sizes about 2.5cm. It should be explained to the child that the sheets of cardboard represent two fields belonging to two different farmers and that the cubes are supposed to be houses. The child should be asked to compare the two sheets of cardboard at the beginning to establish that they both cover the same amount of space. The farmers are now going to build houses, each on his own field: every time the first farmer builds one, the second farmer will do the same - one farmer will never build a house without the other building one as well. The teacher should make this very clear in her instructions by saying: "Each time one house is built here" (placing house on field) "another house will be built here" (placing a second house on the other field). In this way the child is able to establish the one-to-one correspondence between the two series. The houses are built close together on one sheet and scattered about on the other. After three houses have been built on each field the child is asked if there is still the same amount of space left in both fields.

C012. The teacher can have two identical sheets of paper, again representing two fields but not necessarily regular in shape. The child is asked to superpose one of the other so as to be certain that each contains about the same amount of space. There are two small brown squares, both about the same size, which represent ploughed patches or potato plots. The child can be asked to verify that the two potato plots are the same size, and then one is placed on each field. Once this has been done he can be asked two questions: firstly, "Do both the potato plots cover about the same amount of space on each field?" and secondly, "Is there still the same amount of grass left in both fields?"

One of the brown squares can then be cut into two rectangles which are placed end-to-end, and the child asked: "Is there still about the same amount of space for potatoes here" (in the first field) "as there is in this field?" (second field). Once the child has given his reply the teacher can make the rectangles into a square again and repeat the question, and then make them into a much more irregular shape and repeat it again.

Each time the teacher asks the question about the space available for the potatoes, she should also ask the question about the amount of grass left in the two fields.

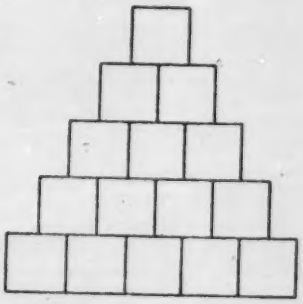
C013. Have several sheets of different colored thick paper and a pair of scissors. The child is asked to cut out two different colored gardens, or fields, in such a way that each garden will cover about the same amount of space as the other. The initial instructions are flexible so as to allow the teacher to see how the child understands the idea of "about the same amount of space." Should the child have difficulty, however, the following hint could be given: "In each garden or field we should be able to plant as many flowers or potatoes as in the other."

C013. (continued)

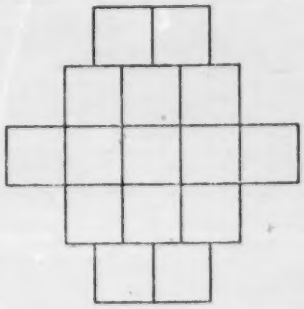
Once children have cut out two gardens that each have about the same amount of space, the teacher can ask them to cut out, from a different colored piece of paper, a third garden that has about the same amount of space as the others but a different shape.

C014. Have two rolls of paper, one about twice the width of the other. A length of paper sufficient to cover the surface of a table could be cut from one roll and the child asked to cut off about enough from the other roll to cover the same area.

C015. Have thirty squares, all the same size, divided into two sets of fifteen. Both sets are arranged in the same way: five squares wide and three squares high, and the child is asked to compare the two configurations. Once he has agreed that they both cover about the same amount of space, one of the sets can be rearranged into a pyramid, e.g.,



or a more symmetrical shape, e.g.,

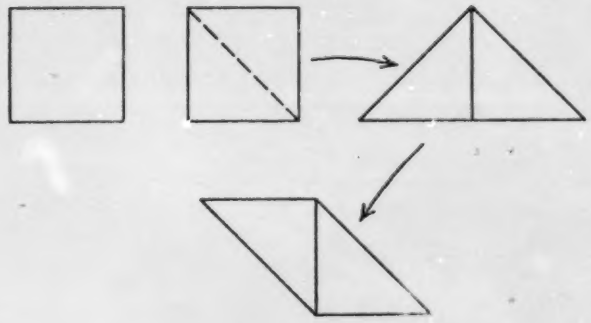


C015. (continued)

The child is then asked if the squares in one set still cover about the same amount of space as those in the other set. If the child has no difficulty with this situation, the squares can be put back into the original rectangle and then spread out into a straight line.

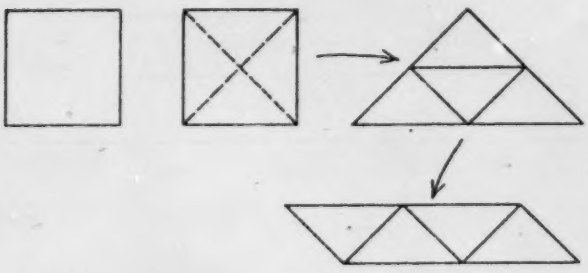
C016. Have three 10cm squares. The child is asked to compare all three squares and once he has established that they each cover about the same amount of space on the desk, one of the squares is cut in half along its diagonal and rearranged to form a triangle (see diagram below). The child can then be asked if the triangle covers as much space as one of the remaining sqaures. Next, the parts can be arranged to form a parallelogram and the same question asked.

Step 1: Diagram



In a second step, the child is asked to look at the two uncut squares and say whether he is sure they both cover the same amount of space. Once he has confirmed this, the two triangles are superposed on one of the squares to form a square again. The child is then asked if the two parts cover about as much space as the remaining square. When he agrees, the two triangles are cut in half along the second diagonal of the original square, after which the parts are rearranged in the following manners and the same questions asked as in Step 1.

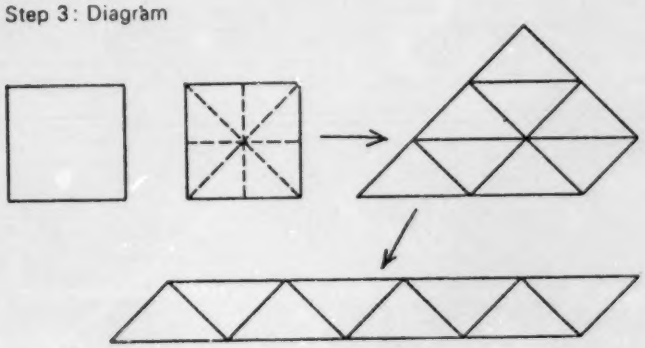
Step 2: Diagram



C016. (continued)

In the last step the procedure is the same as for Step 2, but this time the four right-angled triangles become eight by cutting along the axes of what was the original square. The parts are rearranged as shown below and the same questions asked:

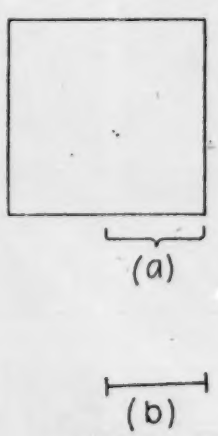
Step 3: Diagram



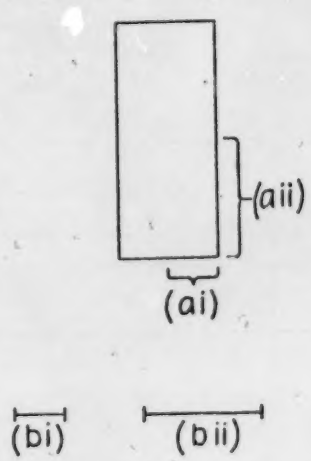
The teacher can use all three of the above-described steps or, according to need, only one or two of them, for example, jumping from 1 to 3 or only doing 1 and 2. In all the steps, the parts of the cut square go from a first new arrangement to a second different arrangement without returning to their original configuration in between.

C017. The child can be given a square or a rectangle and a piece of paper on which the teacher has drawn a line, say, half the length of one of the sides of the shape concerned. The child is asked to reproduce from this base another shape that will cover the same amount of space as the first one.

Situation 1:



Situation 2:



Suggested Activities - COMPARISONS

C1. Provide lots of opportunities for bringing two things together.

a. Pouring or filling one container to another to see which holds more, or less.

b. Cutting up a shape to see if it covers another or if it is larger or smaller.

c. Sorting pairs of anything (shoes, children, toy cars, dolls, etc.) into longer and shorter.

d. Holding two objects to see which is heavier, or which is lighter.

C2. Have child put his name on five tags. Then have him put tags on five things that are taller, wider, older, smaller, or heavier, etc., than he is.

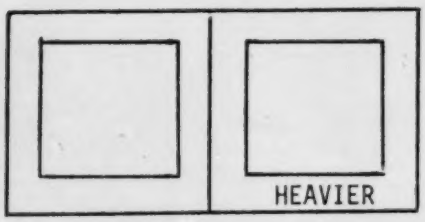
C3. Cut some ribbon (rope, yarn) into different size pieces. Select a piece to do the following activities:

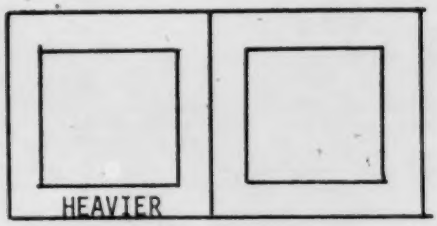
a. Write the name of five things in the classroom longer than your rope.

b. Write the names of five things in the classroom shorter than your rope.

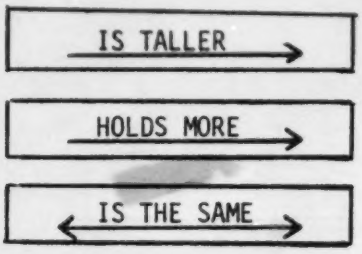
c. Write the names of three things in the classroom you found that were the same length as your rope.

C4. Find containers that are the same size (milk cartons with tops cut off). Set up in a work area pans or dish tubs filled with sand, marbles, cornmeal, beans, tea, nails, etc. Give the children scoops to fill each container with only one of the materials. Then have the children put the containers on cards according to comparison of weight.





C5. Collect a boxful of objects. Place two objects on each of four sheets of colored paper. Ask the child to place arrow cards between the pairs of objects to show how they are related.

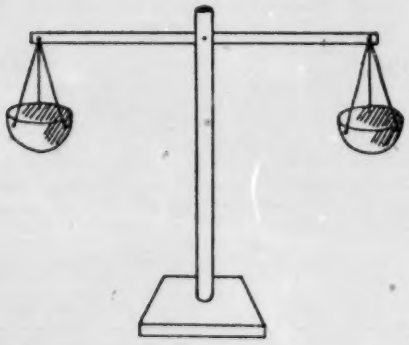


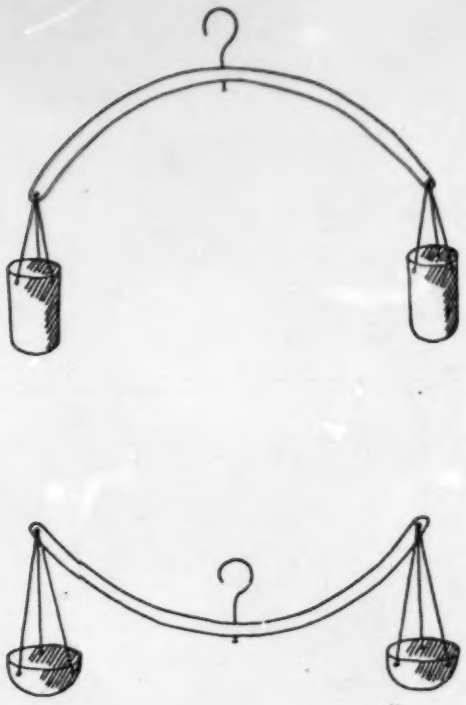
C6. Find pictures in magazine of objects, animals, etc. Cut out the pictures. Group the pictures in pairs on a piece of paper that has been folded into fractional parts. Make labels such as wider, taller, thinner, shorter, etc. Put an appropriate label on one of the objects in each pair.

C7. Fill containers of not obviously different sizes with anything: marbles, sand, macaroni, etc. to compare which holds more (is larger). Some exercises could involve the same amount.

C8. Give the child two objects of different weights to hold in each hand. Have him decide which one is heavier or lighter, or whether the one is the same as the other.

C9. Use a simple balance with its pans to hold the two objects being compared. It is wise to begin by comparing objects of equal weight to show that the beam will remain level. Child can be lead through activities so that he understands how to use scale. Then provide opportunities to compare objects of varying weights. If no balance scale is available, you can make one, using a board and a brick, or a coat hanger and tin cans. Examples are shown below and on the next page.





C10. With a see-saw find out how two children compare to each other in weight.

C11. Using a balance scale have child find objects that will balance with one object (one cotton reel, one washer, etc.,). Questions like this can be asked: "How many nails will balance (weigh the same as) one cotton reel?"

C12. Provide a selected set of containers. They may be chosen for these reasons:

___ they provide a wide range of shapes (rectangular, conical, cylindrical, etc.)

___ they fit well inside each other

___ they show some ordering relationship (short-tall, one holds twice as much as the other)

___ they hold the same amount regardless of apparent looks.

Have child fill these to find relationships in set of containers. Filling materials could be: macaroni, rice, small stones, blocks or beads, metal bottle tops, corks, larger cereals, dried beans, etc.

C13. Give children a box of brightly colored ribbons and strings that vary in length and thickness and have them experiment with them to answer questions such as:

___ What things are as long as your ribbon?

___ Around what things does your ribbon (yarn) go?

___ Does your ribbon (yarn) go across the back of your chair?

___ Does your ribbon (yarn) go around your head?

___ What things are shorter or longer than your ribbon (yarn)?

C14. Use worksheets 101 and 102. Children can find the largest, the smallest and the shapes that are the same.

C15. Use activities C1, C3, C6, and C8. Instead of selecting pairs of things to compare, provide three or more things to compare, and find the "biggest," "smallest," or the ones that are equal.

C16. Have children decide which of two bookcase, desks, seats or chairs, etc. is larger (taller, longer, wider). These should not be noticably different. Choose things in the classroom which can not be moved to make comparisons. Have children devise ways of measuring these things such as a string, or a stick, and then compare the two.

C17. Give children a piece of yarn to measure parts of their bodies (head, foot, waist). Compare these. Find the "smallest," "largest" and the ones that are the same.

C18. Use body measurement (Activity C17) to find out how many head lengths equal a waist length, how many foot lengths equal the height of a body, etc.

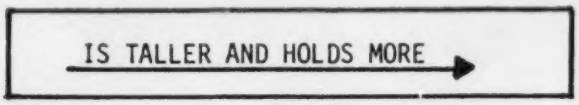
C19. Select two or more children from class who appear to be the same height. Have children "measure" to find out which one is taller (tallest) or shorter (shortest). You may want to find out if they are the same weight.

C20. Cover the tops of two rectangular tables to find out which is larger or to find out if they are the same size in area. Strips of paper, squares, etc., can be used.

C21. Do activities like worksheet 104. Then find out which is shortest, which are the same.

C22. Have child put his name on five tags. Then have him put tags on five things taller and wider, older and smaller, etc., than he is.

C23. Collect a boxful of objects. Place two objects on each of four sheets of paper. Ask the child to place arrow cards between the pairs of objects to show how they are related.



C24. Use box of ribbons and strings (see C13). Have children find lengths that are the same color and thickness, short and wide, etc.

C25. Use any of the activities listed in this section, but provide children with opportunities to compare objects on the basis of 2 properties.

Suggested Activities - ORDERING

01. Collect at least five objects and arrange them in order from large to small. After the teacher checks your work, mix up the arrangement and see if a friend can put the objects in the same order.

02. Have a child fill some bowls, cups, bottles, etc., with any material. Then have him/her place the containers in order starting with the one that holds the largest amount of sand.

03. Select 3 to 5 children. Line them up according to some selected attribute. (hair length, etc.). Have children give the trait (attribute) that was used.

04. Mystery Packages Put different amounts of material in at least five boxes. Wrap each box with different type paper. Order each box according to size (volume). Then order the boxes according to their heaviness.

05. Give a child (or children) some assorted boxes, differing in size, weight, and shape, (there should be no obvious relationship between size and weight) and have them order the boxes by weight or volume (capacity).

06. Give a child (or children) identical containers, but each of a different weight, and have them order the containers.

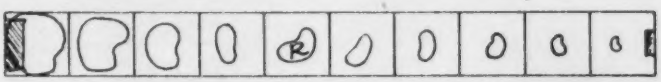
07. Collect leaves and arrange them in order according to area of each. Area could be determined by number of squares that will fit on each or comparison of shapes in which one overlaps the other and is therefore "bigger."

08. Have a box of ribbons and yarns that vary in length and thickness. Order accordingly.

09. Use geoboards if available, if not use page with dots arranged as on worksheets 106 and 107. Have children order rectangles or lines according to number of squares or dots included.

010. Divide class into groups. Have each group secretly decide a human attribute and what it means to have more less of it. The the group can decide who has most of it, who has the next most, and so on. When all groups are ready, each group can present its ordering to the rest of the class so that they can try to guess what attribute was used.

011. Use worksheet 108 with this game. The first child draws a reference card, places it in some middle space and puts a token marked "R" on it to show it is the reference. Successive players draw cards and place them on the proper side of the reference, this time establishing an order in each direction -- from the least area. Shapes already played will probably have to be moved from one space to another in order to place succeeding shapes correctly. When play is finished the board might look like this:



Suggested Activities - ARBITRARY UNITS OF MEASURE

A1. Present situation such as:

> "I'm thinking of moving this bookcase to the rear of the room to fit between the door and the blackboard. Another teacher told me that she didn't think there would be enough room for the bookcase there. How can I find out?"

Hopefully the children will suggest making a "ruler" to measure the length of the bookcase and of the space. They could also suggest a piece of paper or string to measure each length and make a decision. Emphasis is on non-standard units of measure.

A2. Give children these directions:

Take a piece of rope or yarn. Cut a piece that is longer than your height.

a) Measure around your wrist, tie a knot.
b) Measure from the same end of the string your foot, toe to heel, and tie a knot.
c) Measure around your head, tie a knot.
d) Measure around your waist, tie a knot.
e) Measure your height (a friend must help), tie a knot.

Now find how many of one unit equals another measurement on your body.

A3. Use "measurement units" from Suggested Activity A2, to compare two or more things in the classroom. Find out how many more units is one thing from another.

A4. Use a balance scale and provide materials to be weighed. (Materials can include: wooden blocks, marbles, nuts and bolts, large washers, etc.). Have children answer questions like these:

A. How many nails weigh about the same as 10 marbles?
B. How many metal washers weigh about the same as 10 wooden blocks?
C. How many nails weigh about the same as 10 wooden blocks?

A5. Use some fruit (or vegetables) and a balance scale to measure the weight of the fruit. The same materials in Suggested Activity A4 can be used again. Find out how many wooden blocks, marbles, etc. weigh about the same as the fruit.

Worksheet 111 can also be used.

A6. Find out how much bigger one desk top is from another by covering both with the same books, square pieces of paper, strips of paper, match boxes, etc. Have the children compare smaller surfaces. Would they use the book to do the measuring?

A7. Give children a variety of units to find out how much space is on top of their desk. Desk should be rectangular. Materials should include circles, triangles, squares, and irregular shapes. Children will discover why some can be used to measure the entire desk top and why others can not.

A8. Have children measure as many different dimensions on a box as is possible.

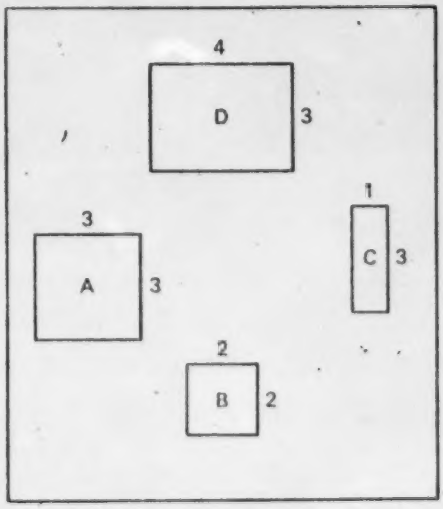
A9. Give children two containers, one slightly larger than the other. Have them find out how much bigger one of them is.

A10. Have children measure as many different things as they can about an adult. Let them use these attributes to describe the adult to some classmates, who try to draw this person. How are these drawings different from regular pictures?

A11. Ask children to select 5 "things" in the classroom; to identify or draw a picture of two attributes they could measure for each thing; and to tell or draw the measuring tool they would use for each measurement.

A12. If there are plants in the room, children can measure them to find out how much they have grown.

A13. Place a board in front of the child with A on the left as in the diagram. Put 36 inch cubes as a "block" on position A. Say "Here is a house on this island. It is built right up to the edge of the water, but it is not in the water.



A13. (continued)

"Using the other cubes, can you make a house on this island (point to B) so that it takes up the same space as the first (on A)? It must fill all the island." If necessary put the instructions as a story. "The people who live here (point to A) move and go to live here (point to B). They must have just the same amount of space in which to live, no more or no less." When the child has finished, do not ask him to explain what he has done, but go on to what follows keeping the building intact on B.

Leave the building on B and use more cubes. Repeat the procedure, this time for building on C a "house" with the same space as that on A. Tell the child to use more cubes and repeat for building on D as on A. As previously the building must fill all the surface of the island.

When the three buildings B, C, D are finished say "Explain (or tell me) what you have done. Are you sure that this house (point to B) contains the same amount of space as that (point to A)? Why?" Ask the same for C and D.

Finally, "How do you know that you are right?" Allow the child to make any alterations or movements that he wishes. Ask him for his reasons for these. Ask all the questions necessary to find out the procedures used by the child.

If the three buildings are equal in volume to A, stop the activity. If not go on to the following; ask each of these questions:

"This house (B) - does it occupy (have) the same amount of space or volume as that (C)?" Repeat for B and D. In the same way compare C and B, C and D and finally D and B, D and C.

A14. Have children use sheets of newspaper to measure the area of various floor and wall spaces around school or home.

A15. With each activity in this section have children estimate what their answer will be before actually measuring.

A16. With each activity in this section have different children check measurement for accuracy. Did both get the same measurement? If not, why?

A17. Use various units of measure to measure the same object. Example:

books and squares (10 sq. cm) to measure the teacher's desk; marbles or metal washers to weight the same as a pencil.

Is there any relationship between the size of the unit or measure and the amount you would have to use to measure? Which unit would be more accurate? The larger unit or the smaller unit? Develop various questions as children are exploring the use of several different units to measure the same thing.

A18. From activities on worksheets 124 and 125, discuss the various things used, e.g. marbles, sand, cubes for filling boxes and other containers; cups or match-boxes to measure the same needed to fill a container. Comparisons can be made - for some 3D shapes, e.g. some of the boxes.

Cubes provide an easy way of measuring the amount of space; for others, it is easier to use a small box to measure sand to fill the container. Further disucssion can bring out the difficulty of comparing the volume (capacity) of containers using these small boxes, etc., as match-boxes, cups, will vary.

SUGGESTED ACTIVITIES - STANDARD UNITS OF MEASURE

S1. Provide children with a metre. Have them measure both inside and on the playground. Record the findings and then have another group check for accuracy of measurement.

S2. Find the distance (length) between two unconnected objects. The need for a straight line will occur. Stretch a rope and measure along rope.

S3. Make a list of all the things that you think are about one (1) decimetre in length. Keep a record.

Objects estimated One decimetre	Measured length to the nearest cm.
Chalk	8 cm.

S4. Have two groups compare their results after measuring something with a unit of their choice. For such activities the teacher can introduce ideas about centimetres and metres.

S5. Have children find out how many grams are equal to whatever arbitrary unit they used to weigh things.

S6. Cut a piece of straw just this length: ——
Find some things in the room that are about that length. List them.

S7. Cut a piece of straw that is this length:

Find some things that are of that length. List them.

The length of this straw is called a decimetre. It is the same length as 10 centimetres.

S8. Measure various objects in the room. Find their measurements to the nearest centimetre or decimetre. Record the measurements and have another student check them.

S9. Use any of the activities listed in the Arbitrary Units section, using a metric measure instead of an arbitrary unit.

S10. Find 3 containers of different sizes and a litre measure. Fill the containers with water and then pour the water into the litre measure. Record the amount for each container to the nearest decilitre.

S11. Use a scale and metric weights. Weigh various small objects to the nearest gram.

OBJECT	WEIGHT (Gram)
paper clip	
penny	

S12. Provide situations in which children must choose the appropriate metric unit with which to measure an object.

Example: What would you use to measure the length of a candle?

S13. Make a collection of cans, bottles, and boxes. Find a way to measure around each container. Estimate the number of centimetres around each container.

OBJECT	ESTIMATED MEASURE (cm)	ACTUAL MEASURE (cm)

S14. Fill a plastic freezer bag with 10 grams (decigram) of sand. Make some estimates of those things which will have a mass or weight of nearly 10 grams (any weight can be substituted). Check your estimate.

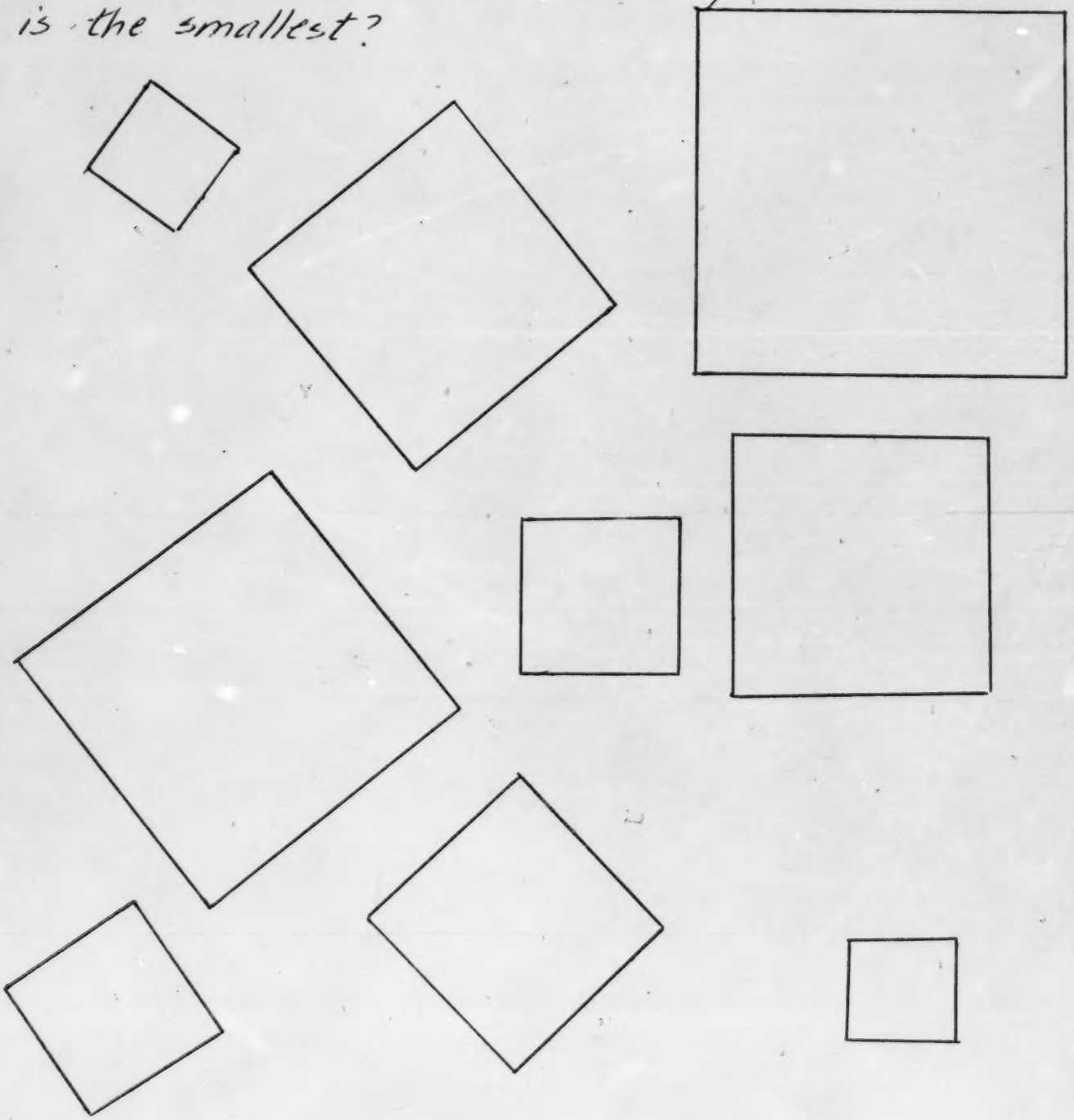
OBJECT (estimated 10g)	LESS THAN 10g	ABOUT 10g	MORE THAN 10g

S15. Find containers in the supermarket that have their weight stated in metric measure. Make a list of these and how many grams each is.

S16. Have students lay out 10 "decimetre straws." Mark the length on another piece of manila paper (or tag board). Cut out this new strip. Allow students to use it to measure themselves and things in the environment. Later on, introduce the name metre (10 decimetres) for this new unit.

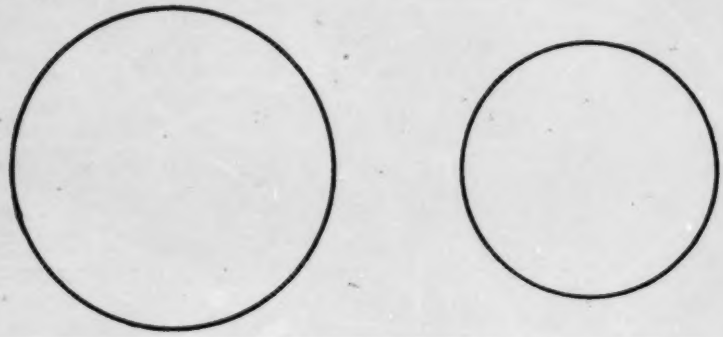
Name _____

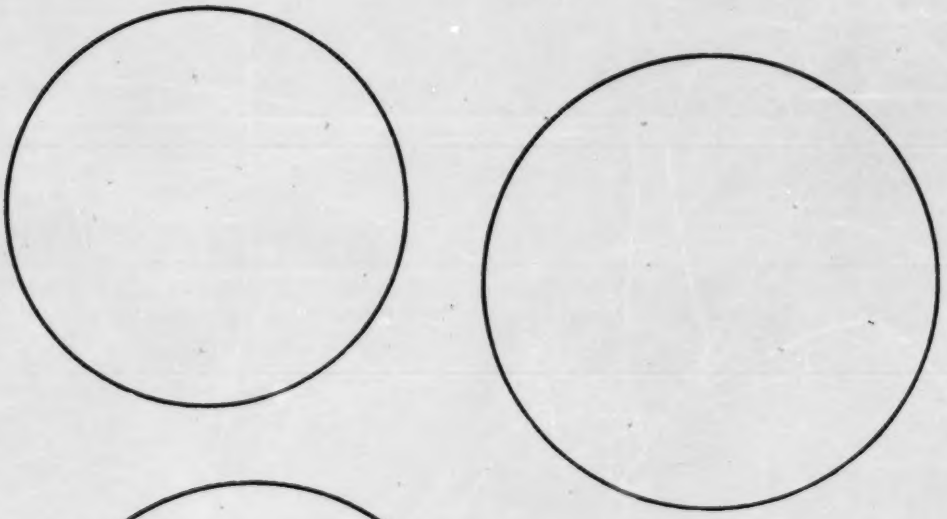
Cut out the shapes. Put them on top of each other. Which is the largest? Which is the smallest?

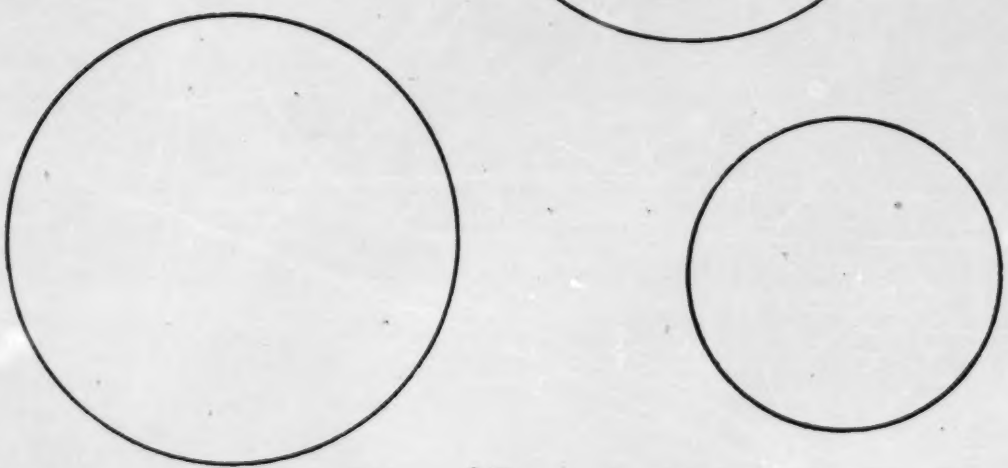


Name _____

Cut out the shapes. Put them on top of each other. Which is largest? Which is smallest? Are there any that are the same?







Name _____

Cut out pictures from a magazine. Paste them on both sides of the arrow to show that the object in the picture is heavier.

IS HEAVIER →

IS HEAVIER →

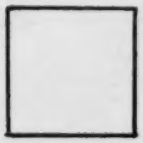
IS HEAVIER →

Name _____

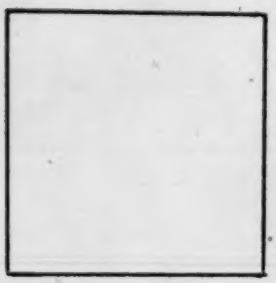
Trace around your foot. Cut it out. Find out how many of your feet each of the things below is.

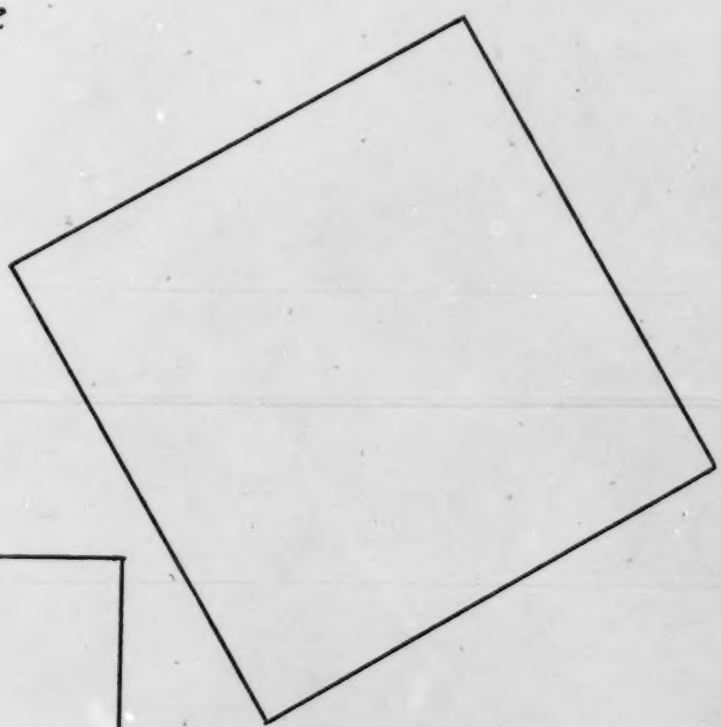
1. Your desk _____
2. The window _____
3. A sink _____
4. The shelves _____
5. Your chair _____
6. A door _____

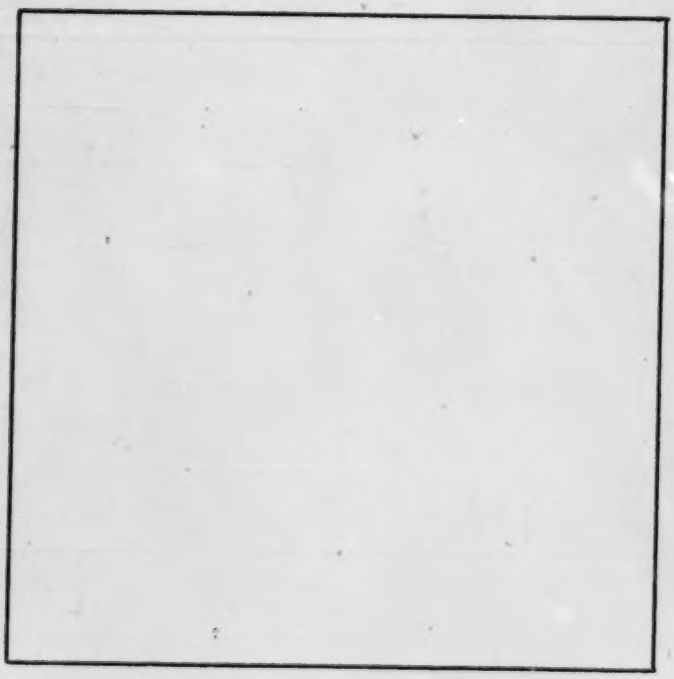
Name _____

Cut out the square: → 

Find out how many squares fit in the boxes below.

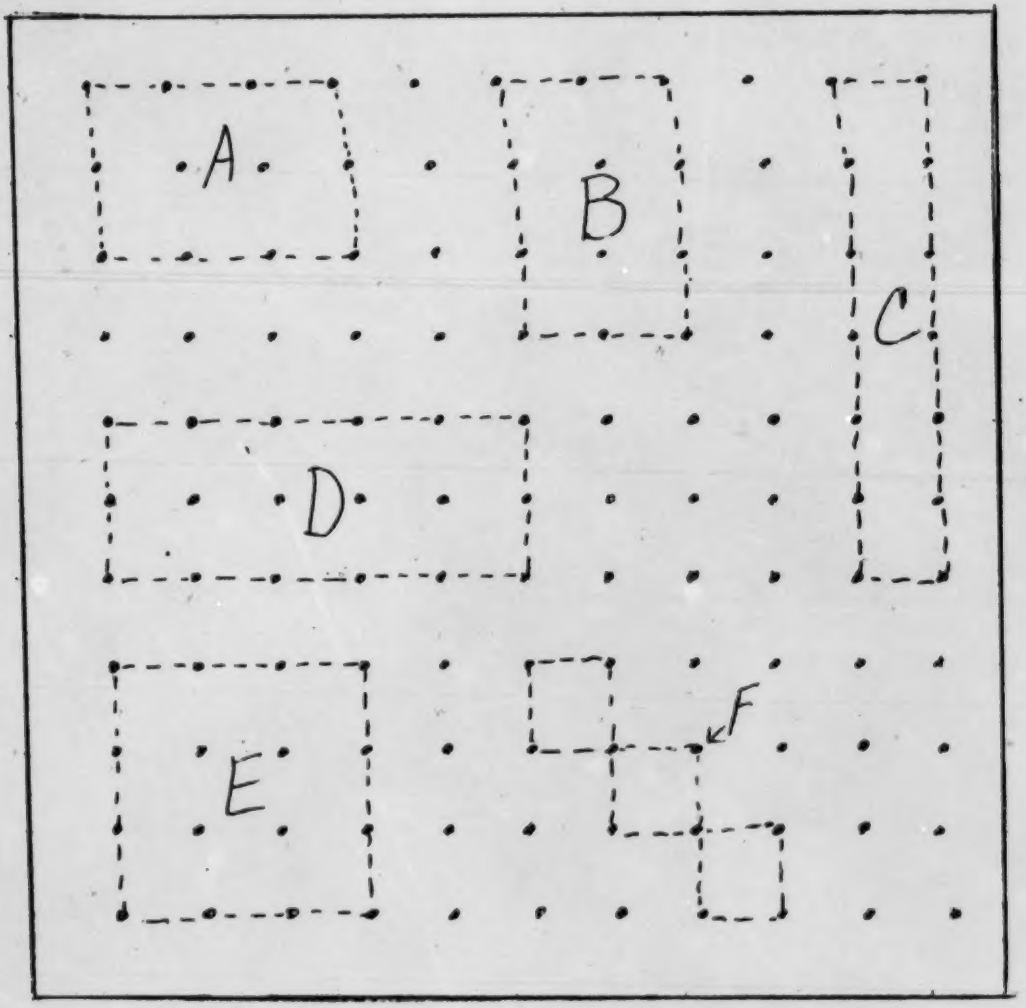






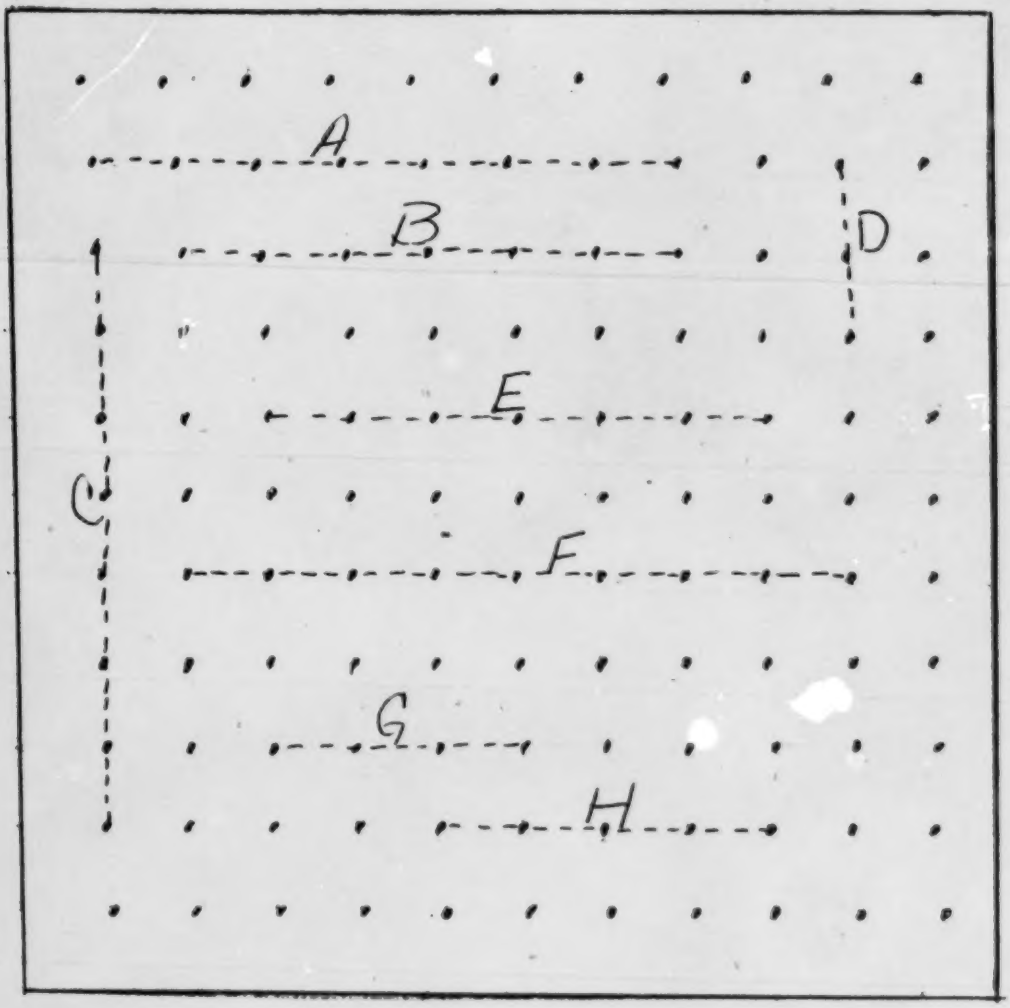
Name _____

Find the largest shape.
Find the smallest shape.
Find the ones that are the same.

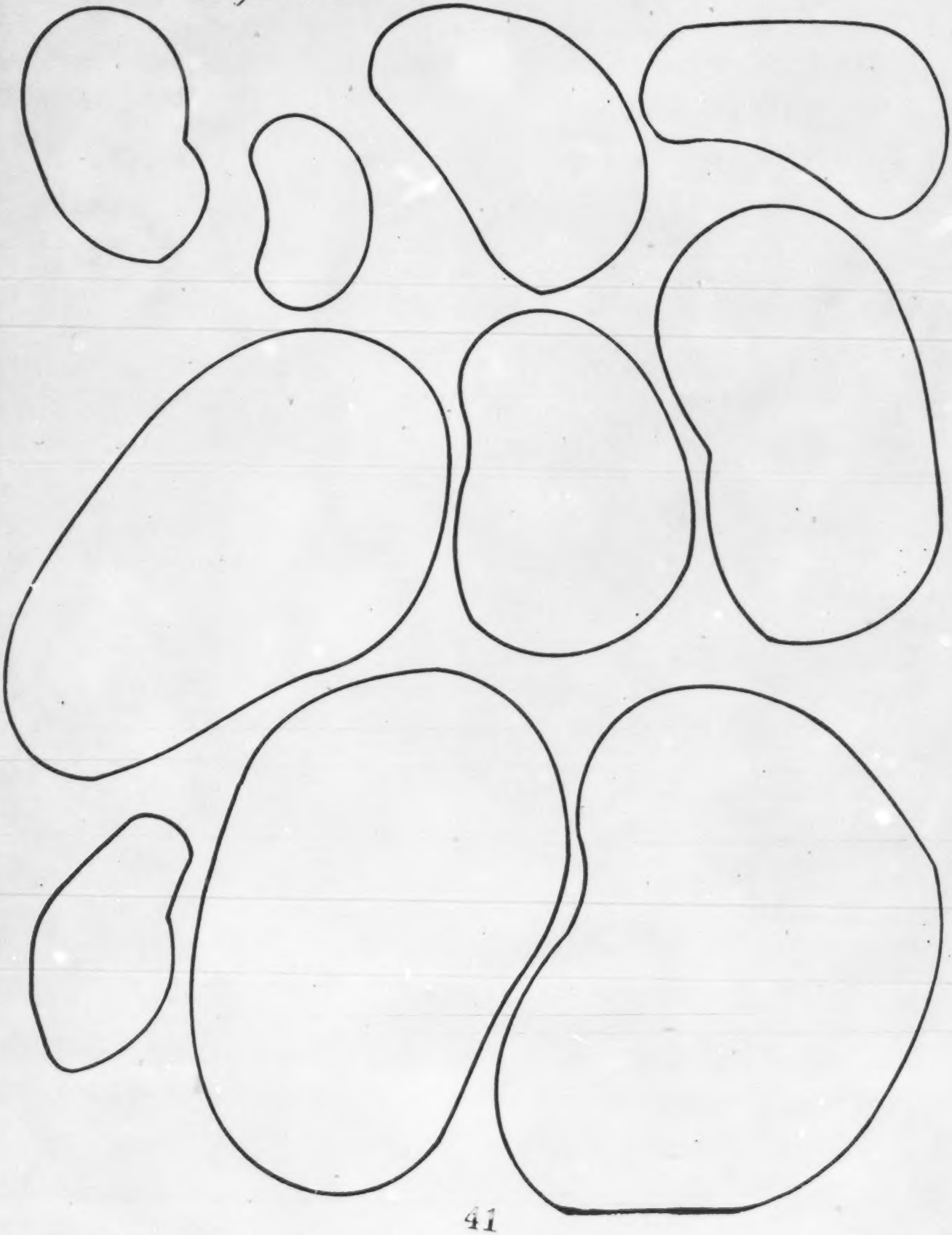


Name _____

Find the longest line.
Find the shortest line.
Find the lines that are the same.



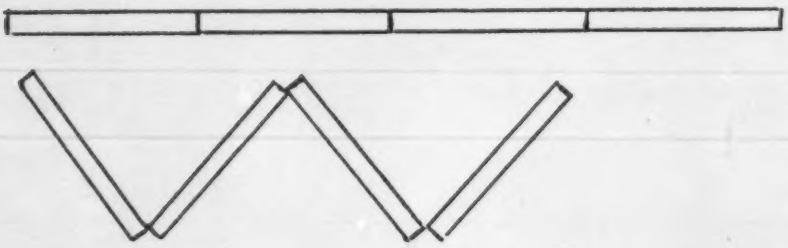
Cut these beans out. Put them in order from largest to smallest.



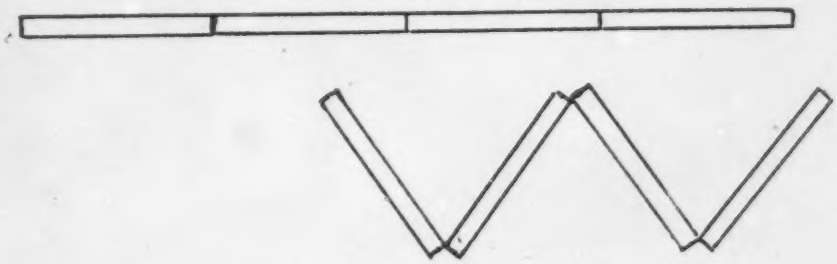
Name _____

Are the paths in each problem the same length?

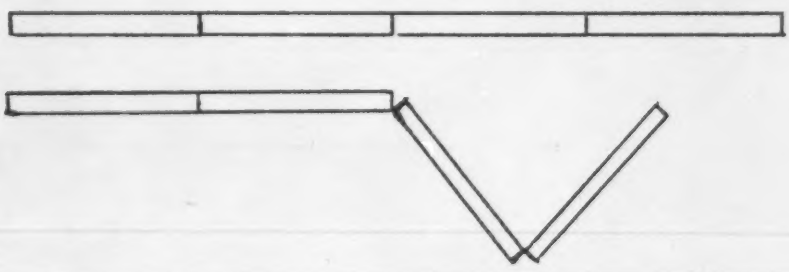
A.



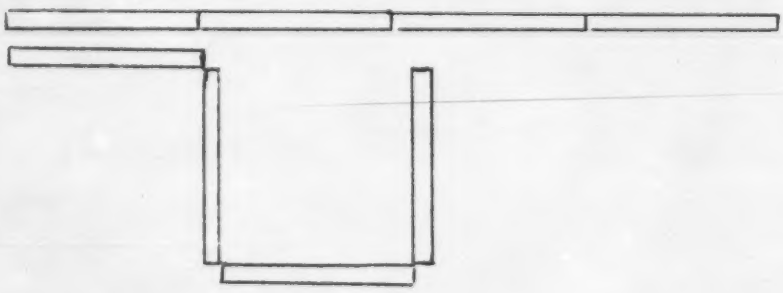
B.



C.

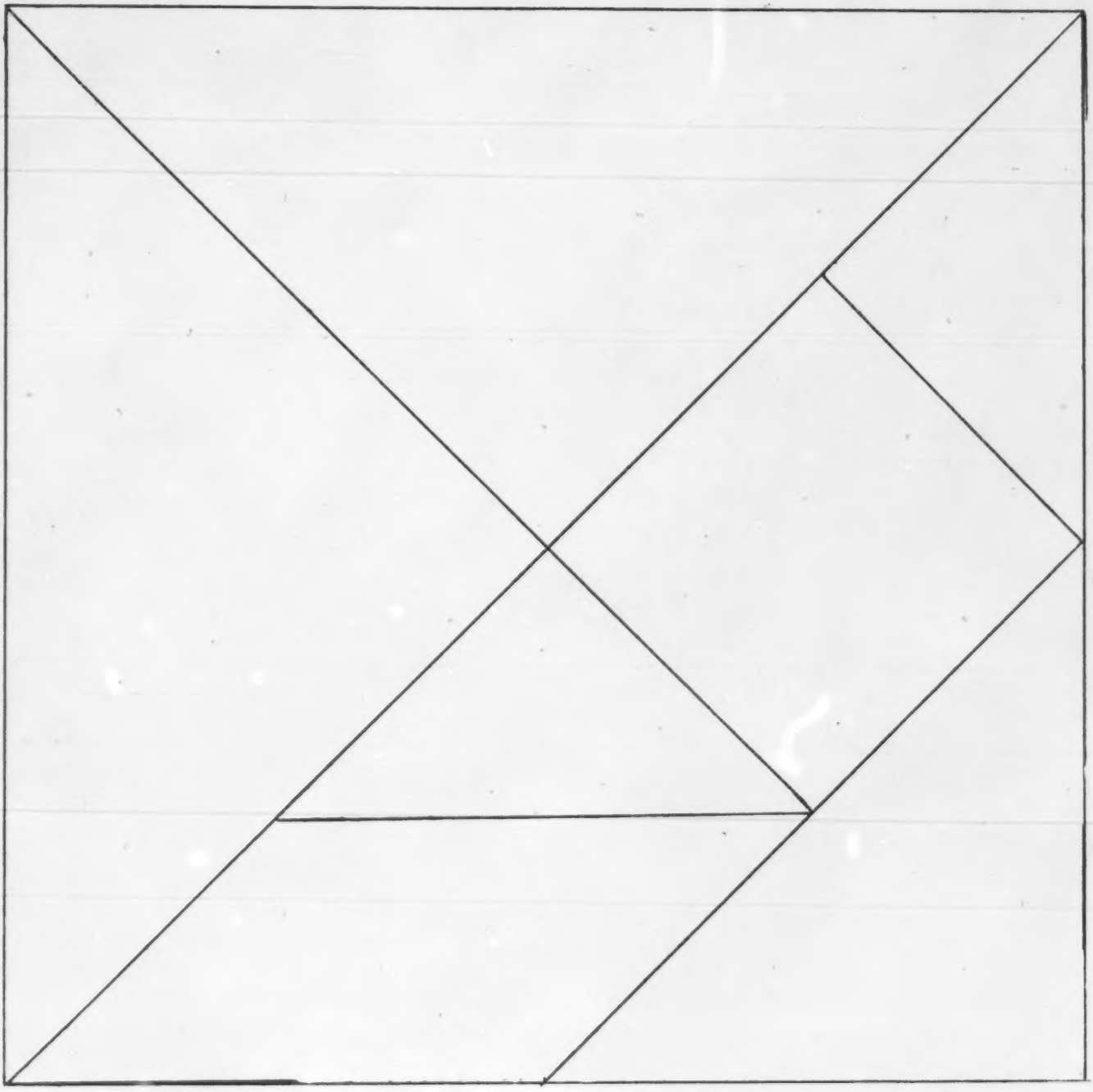


D.



Name. _____

Cut out along the heavy lines.
Find the shapes that fit or top of each other.



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Name _____

How many of each thing on the list will weigh about the same as the apple?

_____ Wooden blocks

_____ Nails

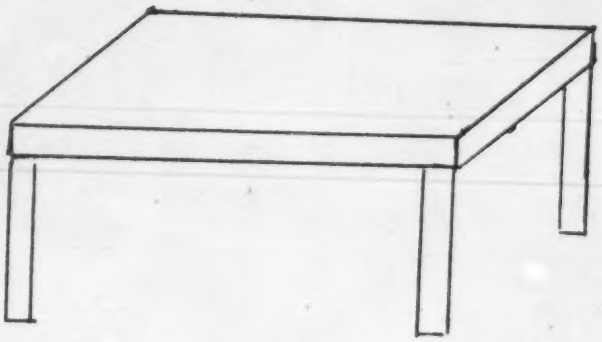
_____ Nuts and bolts

_____ Metal washers

_____ Marbles

Name _____

This is a picture of a table.



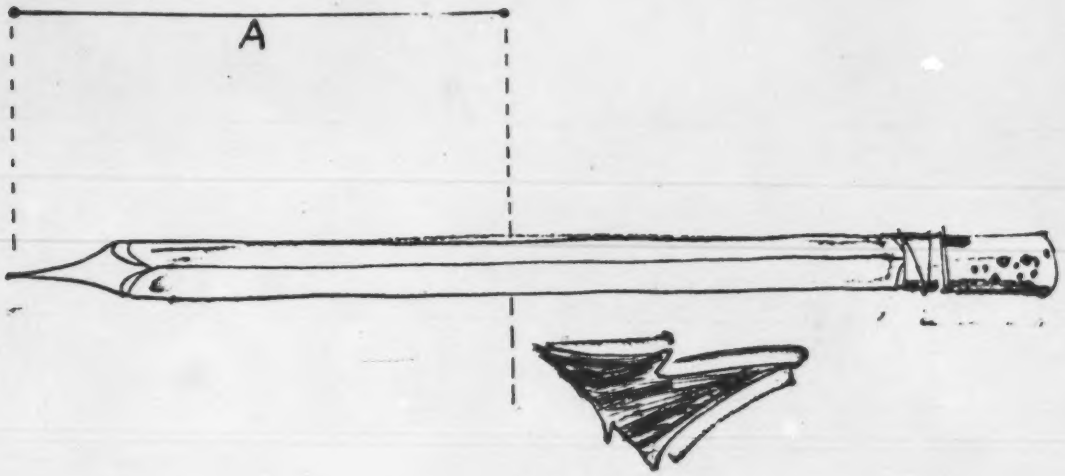
Draw an arrow on every part you could measure.

PAGES 113-116 MISSING FROM DOCUMENT PRIOR TO ITS BEING
BEING SHIPPED TO EDRS FOR FILMING.

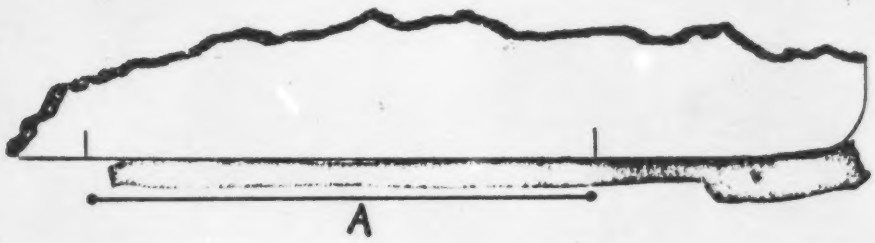
BEST COPY AVAILABLE

Name _____

Use your pencil to measure line A.

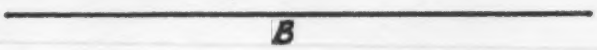


Or tear a strip of paper to use as a model of line A.

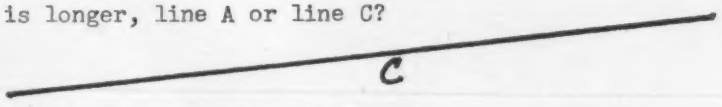


NOW ANSWER THESE QUESTIONS:

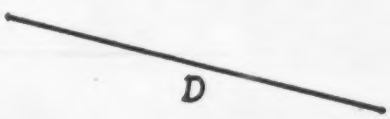
1. Which is longer, line A or line B?



2. Which is longer, line A or line C?



3. Which is shorter, line A or line D?

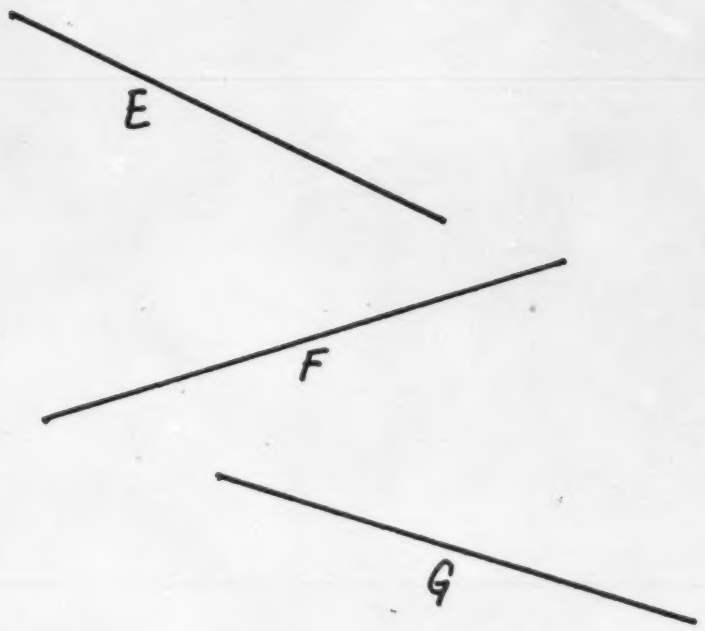


Name _____

4. Which is shorter, line A or line E?

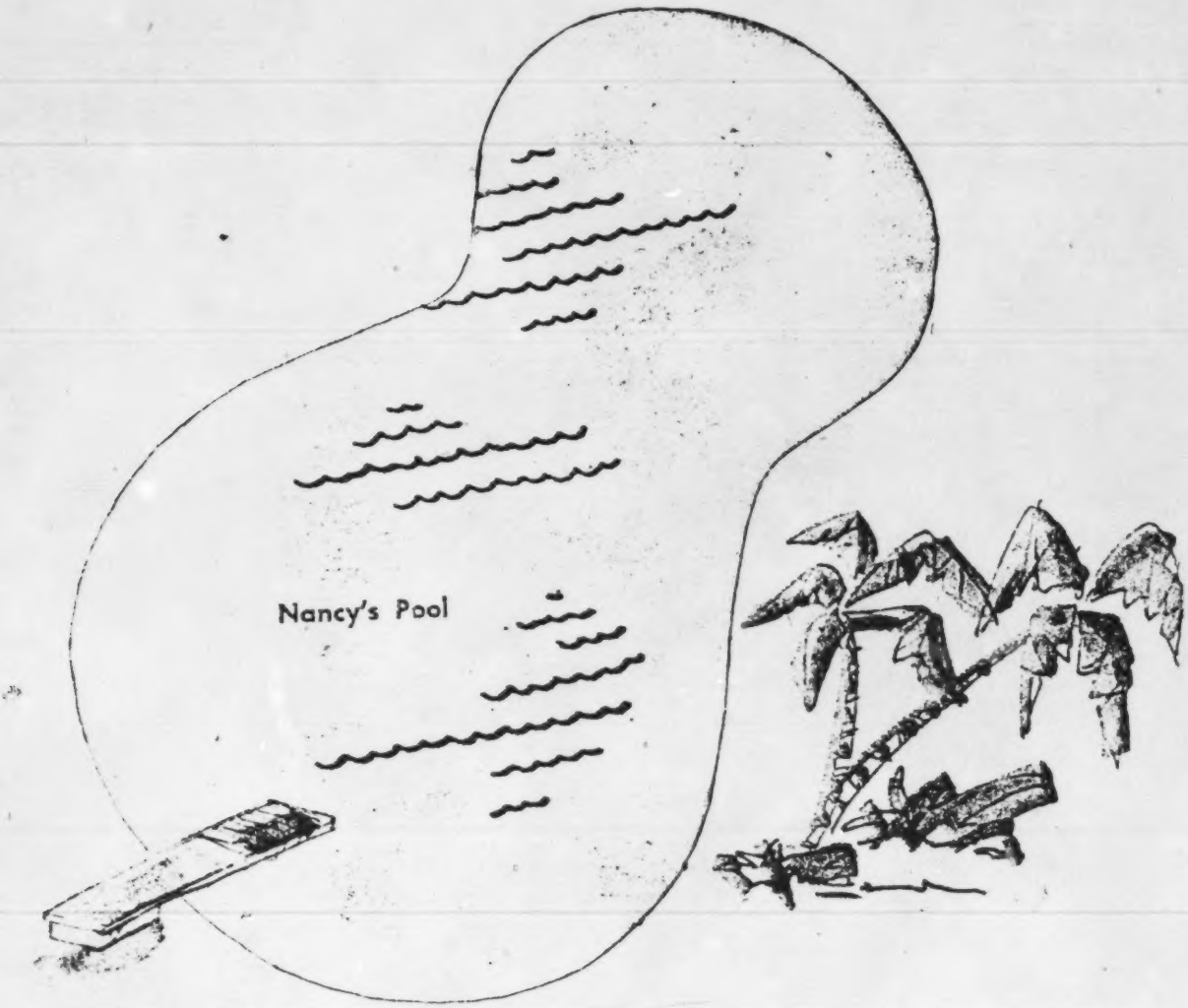
5. How do line A and line F compare?

6. Compare line a and line G. Which is longer?



MEASURING AREA Name _____

On this page and the next one are two pictures of swimming pools. One is in Nancy's yard and one is in Tommy's yard. Which pool has more room for swimming?



The pool with the most room for swimming has the greater area.

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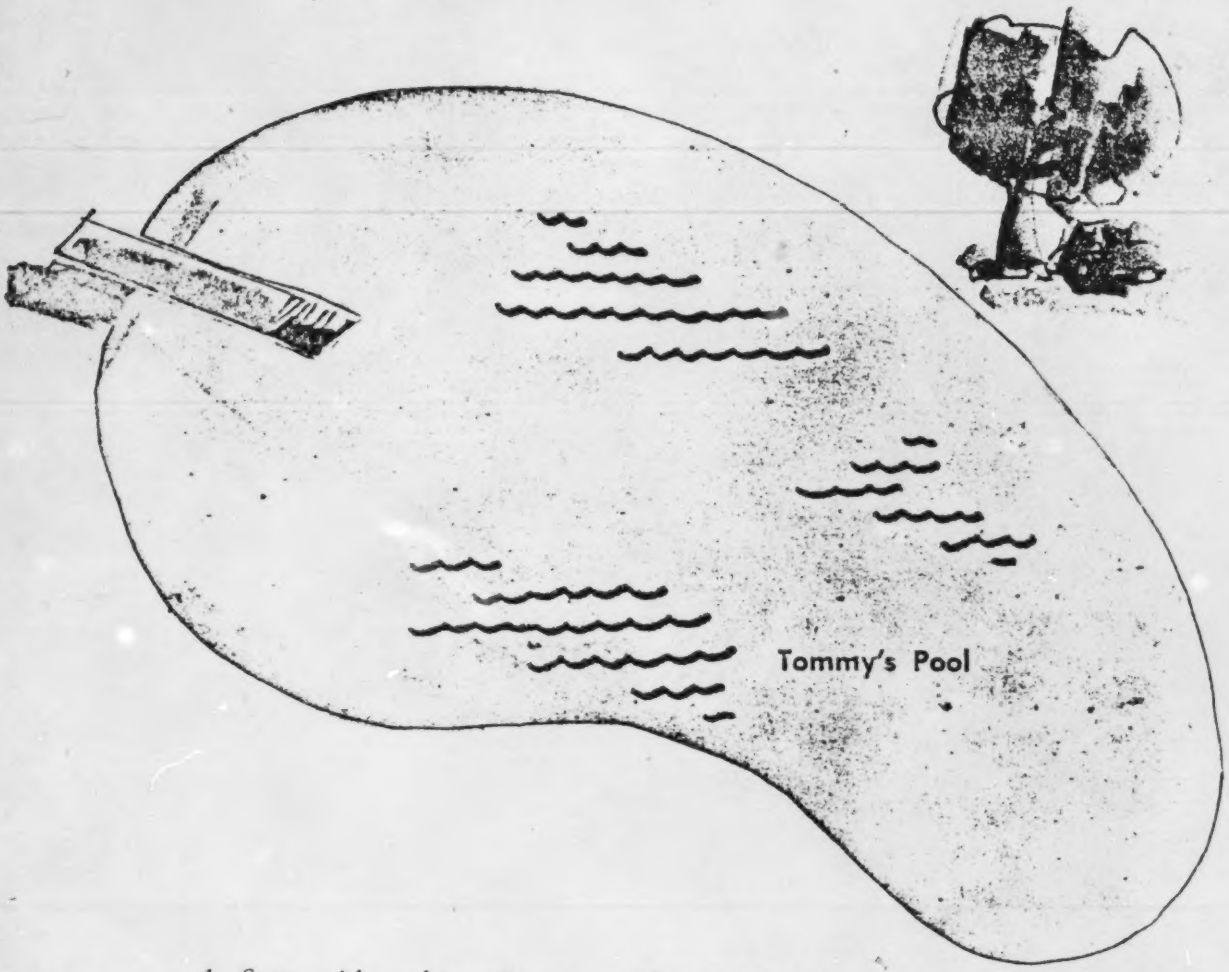
Name _____

How can we find out which pool has more area?



1. Start with a big pile of pennies. How many pennies will it take to cover each pool?
   Cover both pools and then count the pennies.
   Which pool holds more? Compare your answers with your neighbor's answers.

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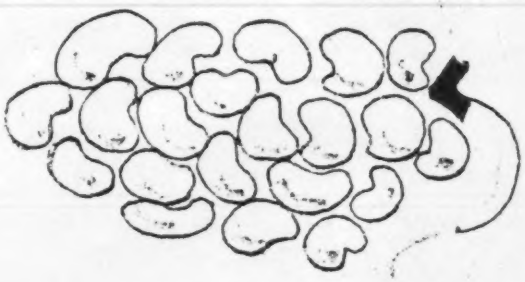
Name _____

2. Now cover the pictures of the pools with beans, bingo markers or checkers.

Compare your answers with your neighbor's.

Could the units of measure you are using be better? How?

Do pennies or beans cover the **whole** surface of the pools?



What shape unit might be better than pennies or beans?

A Triangle?

A Square?

A Rectangle?

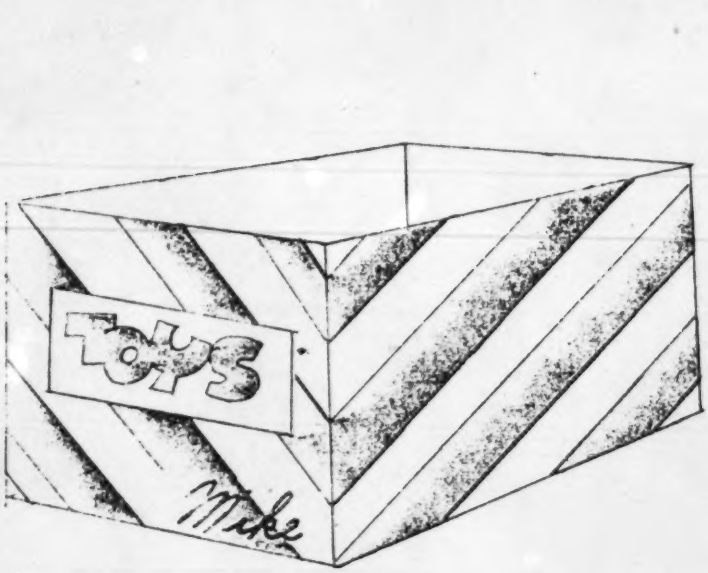
Which would be easiest to use?

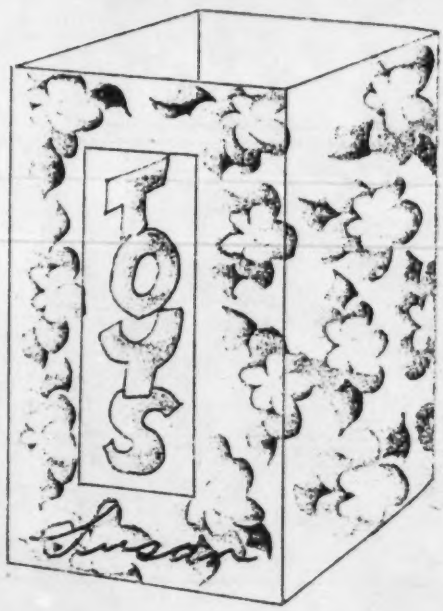
Let's experiment. Cut paper into many equal-sized squares to cover the pools. What about spaces too small to fit a whole square?

Name _____

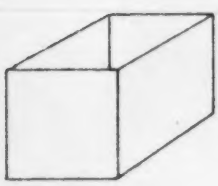
VOLUME

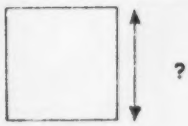
Mike and Susan each have a box for their toys.

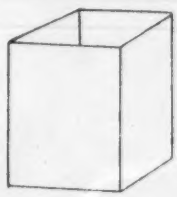


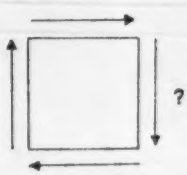


1. How would you find how **tall** (deep) each box is?
   How long each is?
   How wide each is?
2. How would you find the distance **around the top?**









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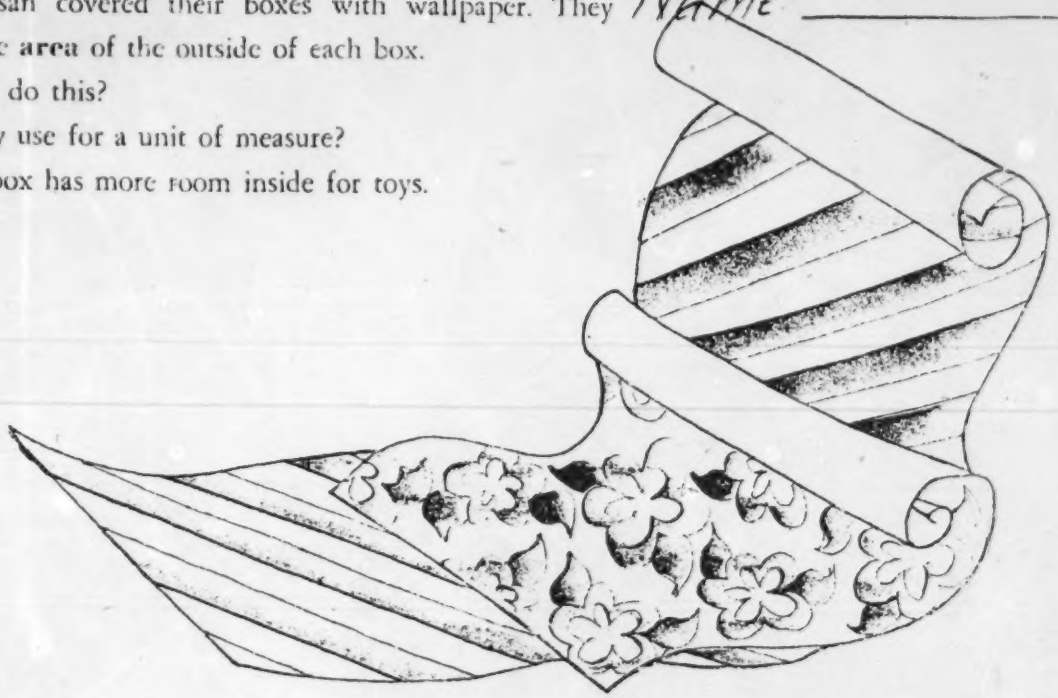
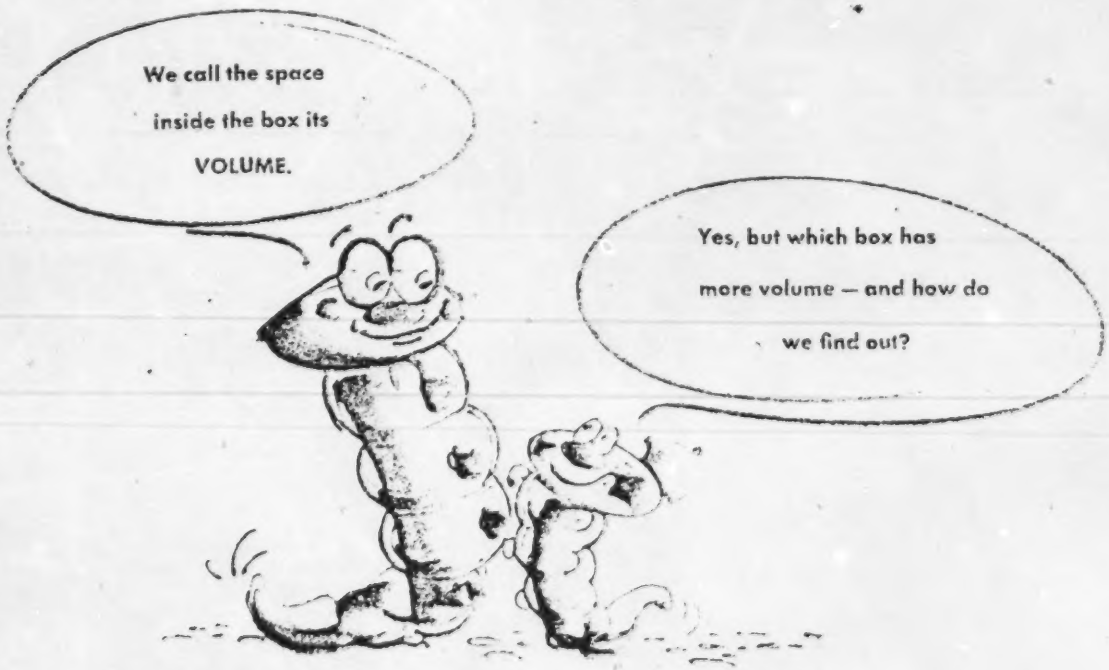
NAME _____

3. Mike and Susan covered their boxes with wallpaper. They had to find the **area** of the outside of each box.
How did they do this?
What did they use for a unit of measure?
Guess which box has more room inside for toys.



Mike thinks his box will hold more toys because it is bigger around the top?

Susan thinks hers will hold more toys because it is deeper.



MEASURING CURVES

How would you measure these lines and shapes?

Could you use a ruler? _____

Could you use a string? _____

Cut a piece of string 1 metre long. Lay it along the curve you want to measure.

Then straighten it out and measure just the part you used.

Guess the length of this line.

Now use your string to measure it. Straighten the string and check the length with a ruler. _____

How close did you come? _____

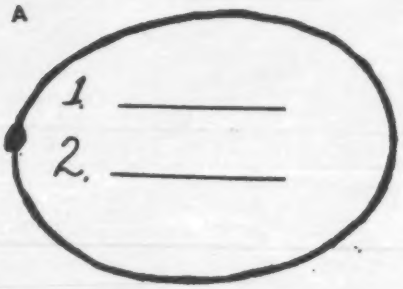
Find other things in the room to measure. Estimate your answer first. Then measure.

1. a globe	_____	_____
2. a wastebasket	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

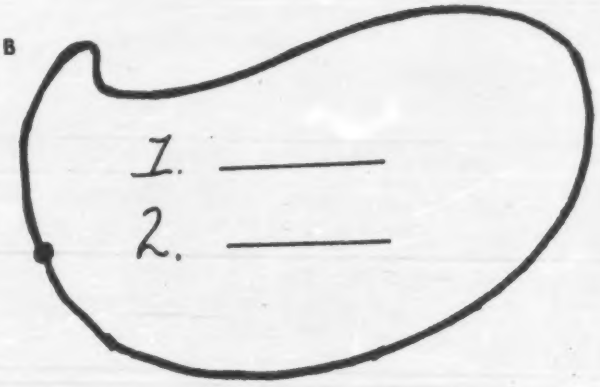
Have a friend check your measurements to see if they are accurate.

Look at the figures marked A, B, and C. Guess how far it is around each figure. Write your guesses on line number 1.

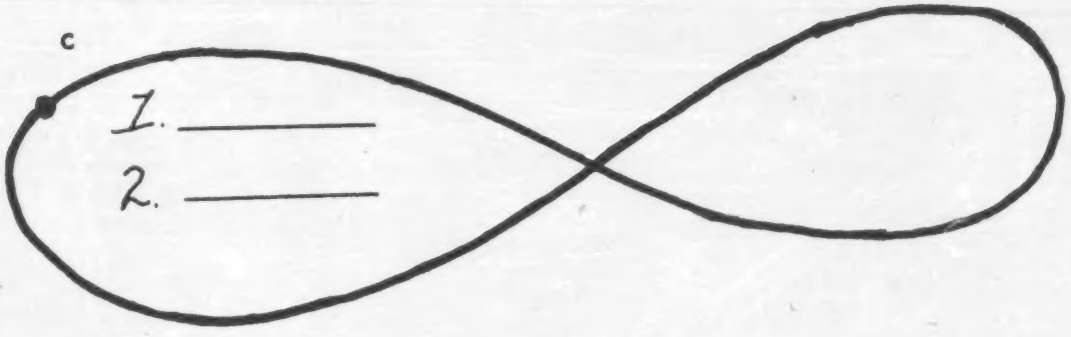
A



B



C



Now use your string and ruler to measure all these figures. Write the measurement on Line 2.

Check to see how close you came. Compare your answers with your neighbor's.

MEASURE HUNT

Choose a colored paper strip.

Find something in the room the size of the strip.

Tape the strip by the thing.

7 cm

5 cm

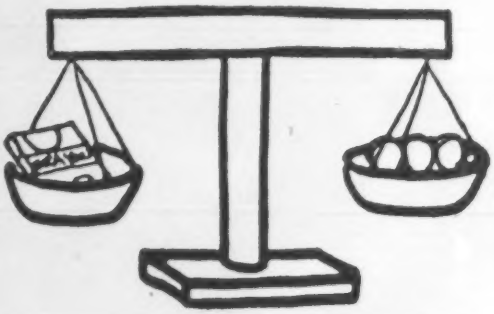
18 cm

4 cm

6 cm

HANG TEN

Use 2 nickels for 10 grams.



1. Put something light in the balance.

2. Make a 10 gram weight out of clay.
3. Make as many weights as you need to balance it.

1. Draw a picture or write what you found out.

☆ Which is heavier, 3 pencils or two 10 gram weights?

WHICH IS LONGEST?

- A chain of 10 paper clips

- Two pencils end to end

- 24 centimetres

List from short to long.

GIANT STEP AWARD

Measure the GIANT step of 5 friends.

Make a pin

for the winner.

SHOP METRIC

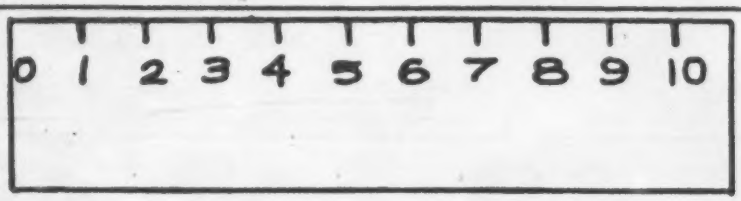
You are going to the store.
You will get:

1. One box (340 grams) of_
2. Two litres of_
3. A 200 gram can of_
4. One *decimetre* of_
5. Two 25 - centimetres long_

Shopping List

- milk
- candles
- tuna
- book
- cornflakes
- *pencil*

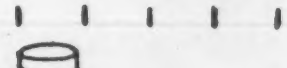
Choose the best answer.



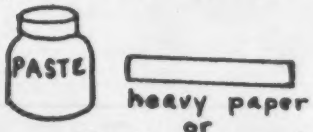
CENTIMETRE RULER

Cut a piece of paper 11 cm long.

Mark the centimetres.



Paste it on heavy paper.



What can you find about 10 cm long?

THE SNAIL

Find

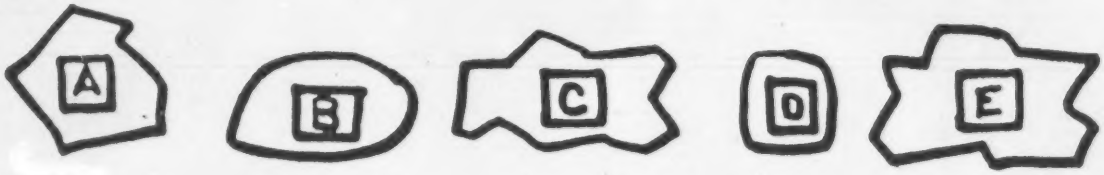
5 things

less than

10 centimetres.

HOW MANY GRAMS ?

Get 5 rocks. Label them.



Put them in order by weight.
Start with the lightest.
Use your gram scale to check.
Write the letters in order.

Why not try 5 books, potatoes, or some other things ?

FINGER MEASURE

Your little finger is about 1 centimetre wide.

Use your finger to tell how wide this is :

1. —
2. —
3. —
4. —
5. —
6. —

USE A STRAW

Cut it one centimetre long.

Measure the lines:

1. _____ 4cm

2. ____ ☐

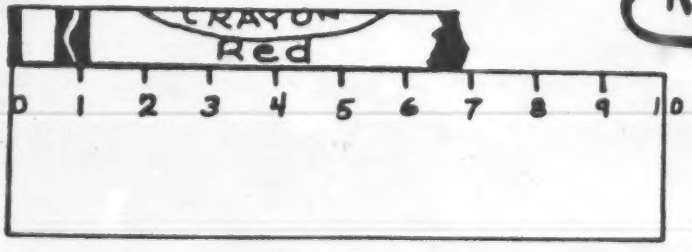
3. _____ ☐

4. _____ ☐

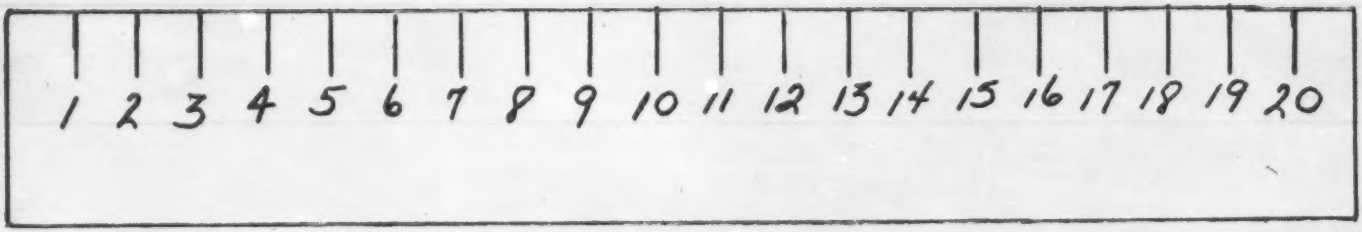
Maybe you can string 10 straws together to measure longer lines.

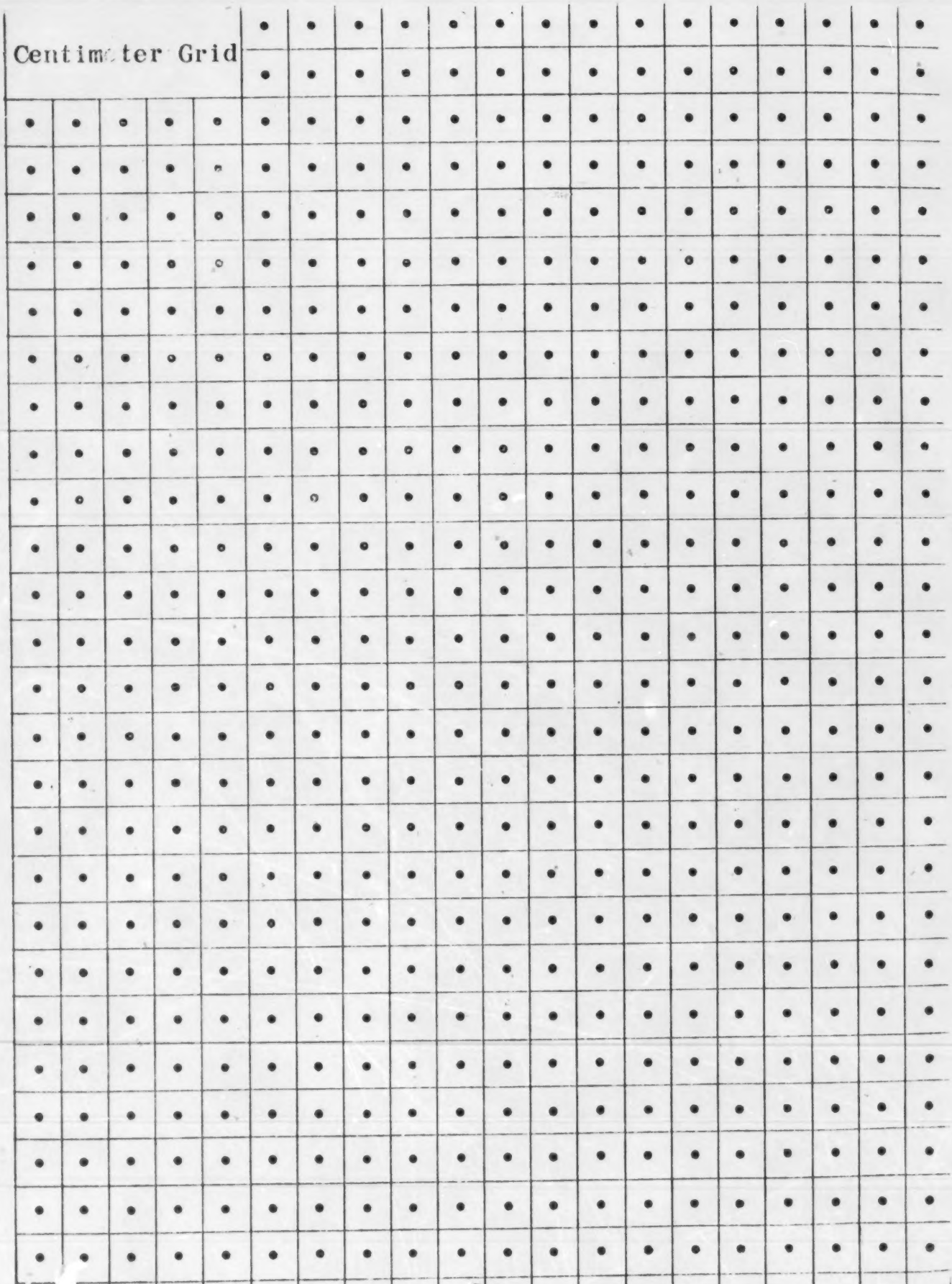
LINE UP

Measure 5 different crayons in centimetres.



Line up the ruler with the zero at one end of the crayon.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20


Centimeter Grid